# PATENT ABSTRACTS OF JAPAN

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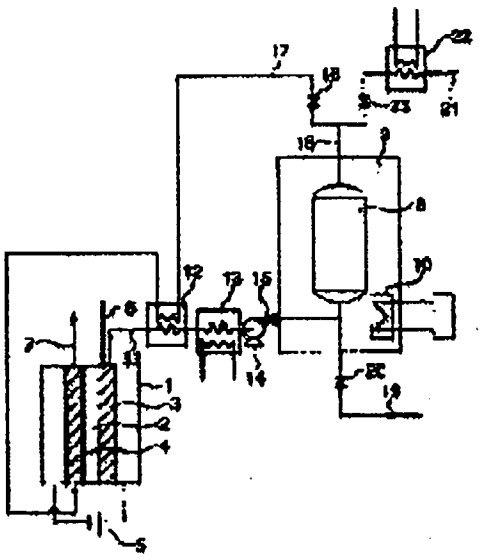
(71)Applicant : MITSUBISHI HEAVY IND LTD
(72)Inventor : IZUMI JUN
YASUTAKE AKINORI
TOMONAGA NARIYUKI
TSUTAYA HIROYUKI

## (54) STORING METHOD OF OZONE AND ITS DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide such a storing method of ozone and its device that ozone is produced by using inexpensive electric power such as nighttime electric power and the produced ozone is stored by using a specified high silica adsorbent having large ozone adsorptivity and a high ozone holding rate even in a system in the presence of water, and that ozone can be supplied as required.
SOLUTION: In the storing method of ozone, ozone is produced by operating an ozone generating device 1 and the obtd. ozone-contg. gas is supplied to an ozone reservoir 8 packed with an ozone adsorbent containing dealuminized faujasite and/or mesoporous silicate to adsorb and store ozone at -100°C adsorption temp. The ozone-contg. gas is preliminarily cooled by using an oxygen concentrated gas flowing from the ozone reservoir 8. When ozone is to be used, operation of the ozone generating device is stopped and ozone is recovered from the ozone reservoir 8 by desorption by heating, purging and desorption by heating, reduced pressure desorption, reduced pressure purging and desorption, or reduced pressure purging and desorption by heating.



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Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention generates ozone mainly in the night using cheap electrical and electric equipment, such as power, stores this, and relates to the storage condition of the ozone which is the need and which can emit ozone by the way, and its equipment.

[0002]

[Description of the Prior Art] Ozone is clean, does not have fear of a secondary public nuisance, and handling is an easy oxidizer and it is widely used in fields, such as sterilization, washing, and oxidation bleaching. However, since it was generally easy to be decomposed, a bomb etc. was not able to be filled up with ozone and it was not able to be stored. So, the method which uses the ozone from a silent discharge ozone generator, the ozone generator using an ultraviolet ray lamp, or a water electrolysis ozone generator directly has been taken. That is, only when installing the above-mentioned ozone generator in an activity site and using ozone, the ozone generator was worked and ozone had been obtained. However, it is difficult to deal with the load effect of the side to be used by this method.

[0003] Moreover, although ozone is mainly manufactured using silent ****** or water electrolysis equipment, the rate that the power cost for working occupies these equipments for the manufacture unit price of ozone is high. On the other hand, since a time zone was restricted or the need of ozone was changed, development of the ozone storage equipment which is the need and which can, by the way, take out the ozone content gas of predetermined concentration was demanded.

[0004] Generally, as a storage method of gas, although gas is liquefiable, or occlusion is carried out to an adsorbent and the thing which is the need and for which this is taken out by the way can be considered, generally it is easy to decompose ozone and the place which needs big energy to a liquefaction method is not realistic for liquefaction. Moreover, since it will precede with ozone and will adsorb firmly if uniquely well-known silica gel has the low adsorption capacity of ozone and moisture exists as an ozone adsorbent, moisture is accumulated into silica gel and the amount of adsorption of ozone falls [ the part ]. Furthermore, since a considerable amount decomposes ozone while adsorbing in silica gel, ozone recovery falls substantially. There is also a possibility that silica gel may powder by adsorption of moisture in the long run further again. Thus, the ozone storage equipment using silica gel lacks in practicability.

[0005]

[Problem(s) to be Solved by the Invention] So, in this invention, the above-mentioned problem is solved, ozone is manufactured by cheap electrical and electric equipment, such as power, at night using the specific high silica adsorbent which has big ozone adsorption capacity and high ozone retention also in the system in which moisture exists, this is stored, and it is going to offer the ozone storage condition which can supply ozone at the time of the need, and its equipment. Moreover, it is going to offer the ozone storage condition which can reduce the operation cost of equipment, and its equipment with a specific combination with an ozone generator.

[0006]

[Means for Solving the Problem] This invention succeeded in solution of the above-mentioned technical problem by adopting the next configuration.

An ozone generator is worked and ozone is generated. (1) A high silica PENTA sill zeolite, Said ozone content gas is supplied to the ozone storage tank filled up with one sort or two sorts or more of ozone adsorbents chosen from the group of dealuminization faujasite and meso porous silicate. - Adsorb and store ozone at the adsorption temperature of the range of 100 degrees C - 0 degree C, and cool said ozone content gas beforehand using the oxygen concentration gas of the low temperature which flows out of said ozone storage tank. On the other hand, the storage condition of the ozone characterized by suspending the aforementioned ozone generator at the time of the activity of ozone, and collecting ozone from said ozone storage tank by heating desorption, heating purge desorption, reduced pressure desorption, reduced pressure purge desorption, or heating under reduced pressure purge desorption.

[0007] (2) SiO2 / aluminum 2O3 of said high silica PENTA sill zeolite A ratio 70 or more They are SiO2 / aluminum 2O3 of 100 or more things and said dealuminization faujasite preferably. A ratio 20 or more They are 50 or more things, and SiO2 / aluminum 2O3 of said meso porous silicate preferably. It is the above (1) whose ratio is characterized by using 50 or more things preferably 20 or more. Storage condition of the ozone of a publication.

[0008] (3) The above characterized by carrying out heating desorption and collecting ozone by setting said adsorption temperature as the range of -60 degrees C - -30 degrees C, and setting said desorption temperature as the range of 0-30 degrees C (1) Or (2) Storage condition of the ozone of a publication.

[0009] (4) The above characterized by heating the purge gas for which it was suitable like an activity eye of ozone in said desorption process, carrying out heating purge desorption of a sink and the ozone for said purge gas to the gas stream and hard flow of said adsorption process, and collecting ozone (1) - (3) Storage condition of the ozone of any one publication.

(5) The above characterized by using nitrogen, a dried air, an argon, helium, etc. as said purge gas (4) Storage condition of the ozone of a publication.

[0010] (6) The above characterized by collecting ozone by reduced pressure desorption by setting said adsorptive pressure force as the range of 1-5atm, and setting said desorption pressure as the range of 0.04-0.3atm (1) Or (2) Storage condition of the ozone of a publication.

[0011] (7) The above characterized by collecting ozone for the purge gas for which it was suitable like an activity eye of ozone by the sink and reduced pressure purge desorption to the gas stream and hard flow of said adsorption process in said desorption process (6) Storage condition of the ozone of a publication.

(8) The above characterized by using nitrogen, a dried air, an argon, helium, etc. as said purge gas (7) Storage condition of the ozone of a publication. (9) The above characterized by heating and carrying out heating under reduced pressure purge desorption of said purge gas, and collecting ozone (7) Or (8) Storage condition of the ozone of a publication.

[0012] (10) The above characterized by introducing into the hydrogen pole room of said water electrolysis ozone generator said oxygen concentration gas which flows out of said ozone storage tank, using a water electrolysis ozone generator as said ozone generator, and reducing the power consumption of said water electrolysis ozone generator according to an oxygen depolarization operation (1) - (9) Storage condition of the ozone of any one publication.

[0013] (11) The above characterized by returning said oxygen concentration gas which flows out of said ozone storage tank to the oxygen raw material side of said silent discharge ozone generator, using a silent discharge ozone generator as said ozone generator (1) - (9) Storage condition of the ozone of any one publication.

(12) The storage condition of ozone the above (10) characterized by using the water electrolysis ozone generator of a high voltage specification, or the silent discharge ozone generator of a high voltage specification as said ozone generator, or given in (11).

[0014] (13) In the ozone storage equipment which has an ozone generator and the condensator attachment heat insulation machine which held the ozone adsorption tub A water electrolysis ozone generator is used as an ozone generator. To said adsorption tub A high silica PENTA sill zeolite, It is filled up with one sort or two sorts or more of ozone adsorbents chosen from the group of dealuminization faujasite and meso porous silicate. Said ozone adsorption tub is connected with said ozone generator with a conduit. the object for ozone content gas supply -- Said adsorption tub and said heat exchanger are connected with a conduit. this -- the object for oxygen concentration gas circulation which prepares a heat exchanger, a condensator, a compressor, and a selector valve in a conduit, and flows out of said adsorption tub -- Connect a conduit to the hydrogen pole room of said water electrolysis ozone generator, supply said oxygen concentration gas to a hydrogen pole room, and oxygen depolarization is urged. furthermore, said object for oxygen concentration gas circulation -- A conduit is connected. said object for oxygen concentration gas circulation -- the edge of said adsorption tub which connected the conduit -- the object for purge gas supply -- A conduit is connected. this -- a conduit -- a heater and a selector valve -- attaching -- said object for ozone content gas supply -- the edge of said adsorption tub which connected the conduit -- the object for ozone recovery -- this, when preparing a selector valve in a conduit and carrying out adsorption storage of the ozone at said ozone adsorption tub said ozone generator and said object for ozone content gas supply -- the condensator of a conduit, and said compressor -- and when controlling a selector valve to work the condensator of said heat insulation machine and to supply ozone content gas to an ozone adsorption tub and carrying out desorption recovery of the ozone from said ozone adsorption tub said ozone generator and said object for ozone content gas supply -- the condensator of a conduit, and said compressor -- and the condensator of said heat insulation machine -- stopping -- said ozone adsorption tub -- said object for purge gas supply -- a conduit and said object for ozone recovery -- the storage equipment of the ozone characterized by forming the controller which controls a selector valve to connect a conduit and to collect ozone.

[0015] (14) In the ozone storage equipment which has an ozone generator and the condensator attachment heat insulation machine which held the ozone adsorption tub A silent discharge ozone generator is used as an ozone generator. To said adsorption tub A high silica PENTA sill zeolite, It is filled up with one sort or two sorts or more of ozone adsorbents chosen from the group of dealuminization faujasite and meso porous silicate. Said ozone adsorption tub is

connected with said ozone generator with a conduit. the object for ozone content gas supply -- Said adsorption tub and said heat exchanger are connected with a conduit. this -- the object for oxygen concentration gas circulation which prepares a heat exchanger, a condensator, a compressor, and a selector valve in a conduit, and flows out of said adsorption tub -- A conduit is connected to the oxygen material gas supply side of said silent discharge ozone generator. furthermore, said object for oxygen concentration gas circulation -- A conduit is connected. said object for oxygen concentration gas circulation -- the edge of said adsorption tub which connected the conduit -- the object for purge gas supply -- A conduit is connected. this -- a conduit -- a heater and a selector valve -- attaching -- said object for ozone content gas supply -- the edge of said adsorption tub which connected the conduit -- the object for ozone recovery -- this, when preparing a selector valve in a conduit and carrying out adsorption storage of the ozone at said ozone adsorption tub said ozone generator and said object for ozone content gas supply -- the condensator of a conduit, and said compressor -- and when working the condensator of said heat insulation machine, and controlling a selector valve to supply ozone content gas to an ozone adsorption tub and carrying out desorption recovery of the ozone from said ozone adsorption tub said ozone generator and said object for ozone content gas supply -- the condensator of a conduit, and said compressor -- and the condensator of said heat insulation machine -- stopping -- said ozone adsorption tub -- said object for purge gas supply -- a conduit and said object for ozone recovery -- the storage equipment of the ozone characterized by forming the controller which controls a selector valve to connect a conduit and to collect ozone.

[0016] (15) The above characterized by having worked said heater, having heated the adsorbent and making heating desorption possible when attaching a heater to the heat insulation machine which held said ozone adsorption tub and carrying out desorption of the ozone from said ozone adsorption tub (9) Or storage equipment of ozone given in (10).

(16) said object for ozone recovery -- the above (9) characterized by attaching a reduced pressure type ozone recovery means to a conduit Or storage equipment of ozone given in (10).

[0017]

[Embodiment of the Invention] This invention fills up the adsorption container of ozone storage equipment with the specific high silica ozone adsorbent which has big ozone adsorption capacity and high ozone retention also in the system in which moisture exists. When an ozone generator is worked by cheap electrical and electric equipment, such as power, at night, ozone content gas is comparatively adsorbed and stored at low temperature at the aforementioned adsorbent and another side and ozone gas are needed They are the storage condition of the ozone with which suspends an ozone generator, emits ozone by heating desorption, heating purge desorption, reduced pressure desorption, reduced pressure purge desorption, heating under reduced pressure purge desorption, etc., and an activity is presented, and its equipment.

[0018] Drawing 1 -2 are the conceptual diagram of the ozone storage equipment of this invention, and ozone storage equipment mainly consists of ozone generators 1 and 24 and a condensator 10 attachment heat insulation machine 9 which holds the adsorption tub 8. In addition, it is also possible to attach the heater for heating the adsorption tub 8 to the heat insulation machine 9, and to use for heating desorption. In drawing 1 , drawing 2 uses the silent discharge ozone generator 24 as an ozone generator, using the water electrolysis ozone generator

1 as an ozone generator. The magnitude of an adsorption tub is determined in consideration of the amount of the ozone used at once, and the total amount of the ozone generated by electrical and electric equipment of the cheap time zone of power rates, such as night, although based also on the engine performance of the ozone adsorbent with which it is filled up.

[0019] the water electrolysis ozone generator 1 of drawing 1 -- ion exchange membrane 2 -- the ozone pole room 3 and the hydrogen pole room 4 -- inserting -- the ozone pole room 3 -- the object for water supply -- a conduit 6 -- the hydrogen pole room 4 -- the object for the hydrogen effluence of gas -- the conduit is connected. And it has structure which held the whole with the separator. Where it opened selector valves 15 and 18 and selector valves 23 and 20 are closed with the equipment of drawing 1 the electrical and electric equipment of the cheap time zone of power rates -- the water electrolysis ozone generator 1 and the object for ozone content gas supply -- by working the condensator 10 of the condensator 13 formed in the conduit 11, and the heat insulation machine 9, and a compressor 14, and suspending the heater 22 for purge gas Ozone is generated with the water electrolysis ozone generator 1, ozone content gas is cooled with a heat exchanger 12 and a condensator 13, ozone content gas is supplied to the adsorption tub 8 by the compressor 14, and ozone is made to stick to an adsorbent. Comparatively, after [ which flows out of the adsorption tub 8 ] low-temperature oxygen concentration gas is sent to a heat exchanger 12 through a conduit 16 and a conduit 17 and cools ozone content gas beforehand, it is made to react to the hydrogen pole room 4 of the water electrolysis ozone generator 1 with delivery hydrogen, promotes oxygen depolarization, and reduces the power consumption of the water electrolysis ozone generator 1.

[0020] The condensator 13 of a conduit 11, the condensator 10 of the heat insulation machine 9, and a compressor 14 are suspended. the water electrolysis ozone generator 1 after adsorbing predetermined ozone at the adsorption tub 8, and the object for ozone content gas supply -- closing and selector valves 23 and 20 are opened for selector valves 15 and 18, and the heater 22 for purge gas is worked -- making -- the object for purge gas supply -- the ozone which purge gas is supplied to the adsorption tub 8 from a conduit 21, and is adsorbed -- heating purge desorption -- carrying out -- the object for ozone recovery -- ozone is collected from a conduit 19. Purge gas meets like an activity eye of ozone, and can be chosen suitably. Specifically, dry air, nitrogen gas, gaseous helium, etc. can be used.

[0021] In this invention, when adopting the method which adsorbs ozone at low temperature comparatively and carries out desorption of the ozone at an elevated temperature comparatively, adsorption temperature is set up in -60 degrees C - -30 degrees C, and desorption temperature is good to set it as the range of 0-30 degrees C.

[0022] In this invention, when adopting the method which adsorbs ozone with high voltage comparatively and carries out desorption of the ozone with low voltage comparatively, the adsorptive pressure force is good to set it as the range of 1-5atm, and to set a desorption pressure as the range of 0.04-0.3atm.

[0023] Purge gas is effective in order to promote desorption, but if a lot of purge gas is used, it is desirable that only the part chooses the rate of a purge in 1-2 in consideration of desorption effectiveness in this invention since ozone is diluted. In addition, when the purge gas which

suited in activity eye can be chosen, it is also possible to choose the rate of a purge so that it may become the ozone level which **(ed) in the activity mode.

[0024] in addition -- if adsorption temperature is securable -- the object for ozone content gas supply -- either the condensator 13 of a conduit 11 or the condensator 10 of the heat insulation machine 9 may be omitted. Moreover, when carrying out application-of-pressure adsorption by the compressor 14, carrying out reduced pressure desorption with low voltage comparatively and collecting ozone, it is also possible to omit the supply system of purge gas. It is also possible to attach a heater to a heat insulation room and to use for heating desorption further again. the time of there being a possibility of moisture freezing over within an adsorption tub and degrading an adsorbent -- the object for ozone content gas supply -- the dehumidifier from which moisture can be removed, without decomposing ozone into a conduit as much as possible, for example, a frozen air dryer etc., may be attached.

[0025] The equipment of drawing 2 was what used the silent discharge ozone generator 24 instead of the water electrolysis ozone generator of drawing 1 , the other equipment configuration is the same and the sign also made it the same. Since the same was said of adsorption storage of ozone, and the desorption recovery actuation, explanation was omitted. the object for circulation of the oxygen concentration gas which flows out of the adsorption tub 8 since it is more efficient to use concentration oxygen for the oxygen raw material supplied to the silent discharge ozone generator 24 -- conduits 17 and 26 -- the object for concentration oxygen gas supply -- it is desirable to connect with a conduit 28 and to use oxygen effectively. Moreover, if needed, temperature swing jazz oxygen enricher or the pressure swing jazz oxygen enricher 25 is formed in the preceding paragraph of the silent discharge ozone generator 24, for example, the air supply tubing 27 is connected to oxygen enricher 25, and you may make it supply concentration oxygen gas to the silent discharge ozone generator 24 through a conduit 28.

[0026] Since the ozone adsorbent used by this invention has big ozone adsorption capacity also in the system in which moisture exists, it can enlarge the ozone quantity to be stored per amount of the adsorbent used, and can miniaturize storage equipment. Moreover, since it has high ozone retention, till the activity of ozone, rear-spring-supporter stability can be carried out, it can store at a long period of time, and loss of the storage ozone by the ozonolysis can be prevented. In this invention, meso porous silicate, such as low-temperature acidity composition meso porous silicate which makes dealuminization faujasite, such as a high silica PENTA sill zeolite and a super-stability Y mold zeolite (USY), and MCM-41, FSM-16, and a tetra-ethoxy silane the source of a silica as an adsorbent which has such a property, and low-temperature acidity composition meso porous silicate which makes a low-molecular silicic acid the source of a silica, is used.

[0027] The high silica PENTA sill zeolite used by this invention has the outstanding ozone adsorption capacity, a sodium silicate and fumed silica are used for it as a source of a silica, as an organic template, using tetrapropylammonium bromide, they can carry out hydrothermal synthesis and it can obtain them at 150-180 degrees C. The high silica PENTA sill zeolite of this invention is SiO2 / aluminum 2O3. 70 or more things have a desirable ratio, and 100 or more things are more desirable. In addition, although the high silica PENTA sill zeolite itself is well-known, as for having the above-mentioned ozone adsorption capacity, this invention person etc. finds out for the first time.

prepared ten sorts of adsorbents to the thing of 15, 30, 100, 400, and 1000, and investigated relation with the rate of an ozonolysis. After pouring ozone water of 10 ppm of ozone levels at 25 degrees C to the adsorption tower filled up with the 80ml of the above-mentioned ozone adsorbents and saturating the ozone adsorbent, the ozone level (C1 ppm) of the water which flows out of an adsorption tower was measured, and cracking severity was searched for by the degree type. The result was shown in drawing 7 .

Cracking severity (%) =[(10-C1) /10] x100[0035] For 20% or less of practical range, a high silica PENTA sill zeolite is [ cracking severity ] SiO2 / aluminum 2O3 so that clearly from drawing 7 . A ratio is 70 or more, it is 100 or more preferably, and both dealuminization faujasite and meso porous silicate are SiO2 / aluminum 2O3. A ratio is 20 or more and is 50 or more preferably.

[0036]

[Example] (Example 1) Using a high silica PENTA sill zeolite (SiO2 / aluminum2 O3 ratio = 200), dealuminization faujasite (SiO2/aluminum2 O3 ratio = 70), and MEZOPORASU silicate (SiO2/aluminum2 O3 ratio = 1000) as an ozone adsorbent, commercial silica gel was also used for the comparison and the ozone amount of adsorption was measured. The adsorbent container 31 of the testing device shown in drawing 8 was filled up with the 5g of the above-mentioned ozone adsorbents. The ozone content gas for a trial is what was manufactured with the water electrolysis ozone generator 30, and a gas presentation is O3. 10vol(s)% and O2 H2 O used the 3vol(s)% thing 87vol(s)%.

[0037] The ozone adsorbent was held at 25 degrees C, and ozone content gas adjusted bulbs 35 and 36, set the ozone partial pressure as 0.1atm(s) and 1atm, and introduced it into the adsorbent container. The gas which flowed out the adsorbent container 31 measured the ozone level with the ozone analyzer 34 through the bulb 36 and the cross valve 33. First, the ozone analyzer 34 detected ozone, after checking that the ozone adsorbent had been saturated, closing and bulbs 37 and 38 were opened for bulbs 35 and 36, and a sink and the ozone content gas which carried out desorption were sent for helium gas to the adsorbent container 31 through the cross valve 33 at the ozone analyzer 34. On that occasion, helium gas was added in measured gas through the massflow controller 39, and the quantity of gas flow to the ozone analyzer 34 was held uniformly. In quest of the total amount of the ozone by which desorption was carried out, it considered as the ozone amount of adsorption.

[0038] Drawing 3 shows the obtained ozone amount of adsorption to a graph as contrasted with an ozone partial pressure. Especially as for the ozone amount of adsorption, it turns out that a high silica PENTA sill zeolite and MEZOPORASU silicate are excellent, and dealuminization faujasite is also excellent compared with silica gel so that clearly from drawing 3 . Since the difference of the ozone amount of adsorption of both of drawing 3 corresponds to an ozone throughput temporarily when setting the adsorptive pressure force as 1atm and setting a desorption pressure as 0.1atm(s), it turns out that a high silica PENTA sill zeolite and meso porous silicate are suitable from dealuminization faujasite.

[0039] Next, ozone content gas adjusted bulbs 35 and 36, and set the ozone partial pressure as 0.1atm(s), the temperature of an ozone adsorbent was changed to 30 degrees C from -60 degrees

C, and other conditions calculated the amount of adsorption of ozone like the above. Drawing 4 is the graph which contrasted this adsorption temperature and the ozone amount of adsorption. Especially as for the ozone amount of adsorption, it turns out that a high silica PENTA sill zeolite and MEZOPORASU silicate are excellent, and dealuminization faujasite is also excellent compared with silica gel so that clearly from drawing 4 . Since the difference of the ozone amount of adsorption of both of drawing 4 corresponds to an ozone throughput temporarily when setting adsorption temperature as -60 degrees C and setting desorption temperature as 30 degrees C, it turns out that a high silica PENTA sill zeolite and meso porous silicate are suitable from dealuminization faujasite.

[0040] The adsorbent container 31 of the testing device of drawing 8 is filled up with three sorts of ozone adsorbents, the silica gel used in the example 1, dealuminization faujasite, and meso porous silicate. (Example 2) Set adsorption temperature as 25 degrees C, and the ozone partial pressure of the ozone content gas for a trial is held to 0.1atm(s). Other conditions introduce ozone content gas into the adsorbent container 31 like an example 1, and the ozone analyzer 34 detects ozone. Where it closed bulbs 35 and 36, and bulbs 35 and 36 are closed 1 hour, 4 hours, after holding for 8 hours, respectively, and after [ for 30 minutes and ] after checking that the ozone adsorbent has been saturated Bulbs 37 and 38 were opened, the cross valve 33 was rotated, the adsorbent container 31 was asked for a sink and the ozone content gas which carried out desorption, and the ozone analyzer 34 was asked for the total amount of delivery and the ozone by which desorption was carried out for helium gas. It asked for ozone retention as a rate of the total amount of the ozone by which desorption recovery was carried out to the total amount (ozone amount of adsorption at the time of an adsorption equilibrium) of the ozone introduced into the adsorbent container 31, and it was shown in drawing 5 as contrasted with the holding time. It turns out that retention became low as the holding time became long, and ozone has decomposed only the part. Dealuminization faujasite and MEZOPORASU silicate have little decline in retention compared with silica gel, and it turns out that it is suitable for storage of ozone.

[0041] Next, except having changed adsorption temperature into -60 degrees C, when the holding time was changed like the above and having been asked for ozone retention, it became as drawing 6 . Although the decline in ozone retention to the die length of the holding time is loose compared with drawing 5 measured at the adsorption temperature of 25 degrees C, also after dealuminization faujasite and MEZOPORASU silicate pass for 8 hours, it turns out to the ozone retention of silica gel falling greatly compared with dealuminization faujasite and MEZOPORASU silicate that 92% and high ozone retention are maintained. That is, when carrying out long duration storage of the ozone, it turns out that it is advantageous to using dealuminization faujasite and MEZOPORASU silicate at the lowest possible adsorption temperature preventing loss by decomposition of ozone, and raising the recovery of ozone.

[0042] (Example 3) The meso porous silicate which has the big ozone amount of adsorption Fill up the adsorbent container 31 of the testing device of drawing 8 , and adsorption temperature is set as 32 degrees C. Open bulbs 35 and 36, close bulbs 37 and 38, and the ozone content gas for a trial of an example 1 is introduced by part for 240mlN(s)/. After adding through the massflow controller 39 and diluting helium gas 7 times to the gas which flowed out the adsorbent container 31, the ozone level was measured with the ozone analyzer 34. Drawing 9 is the graph which showed the breakthrough elapsed time in that case, and the relation of an ozone level. In

addition, change of an ozone level was beforehand measured in the state of the vacuum column, and it wrote together to drawing 9 . Moreover, the ozone breakthrough trial was performed repeatedly 3 times. In drawing 9 , the area between the ozone breakthrough curve of a vacuum column and the ozone breakthrough curve of meso porous silicate shows the amount of adsorption of ozone.

[0043] After the ozone level was saturated in the above-mentioned trial, by closing bulbs 35 and 36, opening bulbs 37 and 38, and rotating a cross valve 33, helium gas was passed by part for 305mlN(s)/, and change of the ozone level corresponding to the playback elapsed time of an adsorbent was measured with the ozone analyzer 34 (it is 7 times [ as the above / same ] the dilution concentration of this). Drawing 10 is drawing having shown the playback progress curve, and the amount of ozone collected by desorption is equivalent to the area between the playback progress curve of a vacuum column, and the playback progress curve of meso porous silicate. In the above-mentioned trial, since the amount of adsorption of the ozone for which it asked from drawing 9 , and the amount of ozone collected by the desorption for which it asked from drawing 10 are almost equal, it turns out that ozone was not substantially decomposed between adsorption of ozone, and desorption.

[0044] Drawing 11 and 12 are the graphs which showed the ozone breakthrough curve and playback progress curve for which it asked like drawing 9 and 10 except having changed the adsorption temperature in the above-mentioned breakthrough trial into -60 degrees C from 32 degrees C. Since the amount of adsorption of the ozone which asked also for this trial from drawing 11 , and the amount of ozone collected by the desorption which asked from drawing 12 are almost equal, it turns out that ozone was not substantially decomposed between adsorption of ozone, and desorption.

[0045] (Example 4) The storage experiment of ozone was conducted using the ozone storage equipment of drawing 1 . The water electrolysis ozone generator of 1kg/h of ozone production capacity is used, and they are SiO2 / aluminum 2O3. The ratio held meso porous silicate 100kg which is 1000 in the ozone adsorption tub, cooled at -60 degrees C with the refrigerator of a heat insulation room, worked the water electrolysis ozone generator using the night power from 10:00 p.m. to 6:00 a.m. of the next day, and generated ozone for 8 hours. Ozone 10vol%, the ozone content gas manufactured with the water electrolysis ozone generator consisted of oxygen 87vol% and moisture 3vol%, was introduced into the ozone adsorption tub by flow rate of 4.7m 3 N/h by adsorptive pressure force 5atm, adsorbed ozone, introduced into the hydrogen pole room of a water electrolysis ozone generator the oxygen concentration gas which flows out of an adsorption tower, and aimed at the oxygen depolarization operation. Economization of the power by oxygen depolarization operation was about 35%.

[0046] At the time of the activity of daytime, the cooler of a heat insulation room was stopped, 30-degree C air was supplied by flow rate of 2m 3 N/h by desorption pressure 1atm from the overhead of an ozone adsorption tower, heating purge desorption of the ozone was carried out, and ozone level 23.5vol% gas was by recovery continuously by flow rate 2.5m3 N/h for 8 hours.

[0047]

[Effect of the Invention] By using the above-mentioned configuration for this invention, having big ozone adsorption capacity, the outstanding ozone retention, and a low rate of an ozonolysis also in the system in which moisture exists, and using the specific high silica ozone adsorbent suitable for storage of ozone It became possible to be able to store the ozone manufactured by cheap electrical and electric equipment, such as power, at night in a large quantity with small storage equipment, and to offer the storage condition of the ozone which is the need and which can take out ozone with high recovery by the way.

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[Translation done.]

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TECHNICAL FIELD

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[Field of the Invention] This invention mainly generates ozone using cheap electrical and electric equipment, such as the Nighttime power, stores this, and relates to the storage condition of the ozone which is the need and which can emit ozone by the way, and its equipment.

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[Translation done.]

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PRIOR ART

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[Description of the Prior Art] Ozone is clean, does not have fear of a secondary public nuisance, and handling is an easy oxidizer and it is widely used in fields, such as sterilization, washing, and oxidation bleaching. However, since it was generally easy to be decomposed, a bomb etc. was not able to be filled up with ozone and it was not able to be stored. So, the method which uses the ozone from a silent discharge ozone generator, the ozone generator using an ultraviolet ray lamp, or a water electrolysis ozone generator directly has been taken. That is, only when installing the above-mentioned ozone generator in a use site and using ozone, the ozone generator was worked and ozone had been obtained. However, it is difficult to deal with the load effect of the side to be used by this method.

[0003] Moreover, although ozone is mainly manufactured using silent ****** or water electrolysis equipment, the rate that the power cost for working occupies these equipments for the manufacture unit price of ozone is high. On the other hand, since a time zone was restricted or the need of ozone was changed, development of the ozone storage equipment which is the need and which can, by the way, take out the ozone content gas of predetermined concentration was demanded.

[0004] Generally, as a storage method of gas, although gas is liquefiable, or occlusion is carried out to an adsorbent and the thing which is the need and for which this is taken out by the way can be considered, generally it is easy to decompose ozone and the place which needs big energy to a liquefaction method is not realistic for liquefaction. Moreover, since it will precede with ozone and will adsorb firmly if uniquely well-known silica gel has the low adsorption capacity of ozone and moisture exists as an ozone adsorbent, moisture is accumulated into silica gel and the amount of adsorption of ozone falls [ the part ]. Furthermore, since a considerable amount decomposes ozone while adsorbing in silica gel, ozone recovery falls sharply. There is also a possibility that silica gel may powder by adsorption of moisture in the long run further again. Thus, the ozone storage equipment using silica gel lacks in practicality.

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[Translation done.]

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EFFECT OF THE INVENTION

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[Effect of the Invention] By using the above-mentioned configuration for this invention, having big ozone adsorption capacity, the outstanding ozone retention, and a low rate of an ozonolysis also in the system in which moisture exists, and using the specific high silica ozone adsorbent suitable for storage of ozone It became possible to be able to store the ozone manufactured by cheap electrical and electric equipment, such as power, at night in large quantities with small storage equipment, and to offer the storage condition of the ozone which is the need and which can take out ozone with high recovery by the way.

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[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] So, in this invention, the above-mentioned problem is solved, ozone is manufactured by cheap electrical and electric equipment, such as the Nighttime power, using the specific high silica adsorbent which has big ozone adsorption capacity and high ozone retention also in the system in which moisture exists, this is stored, and it is going to offer the ozone storage condition which can supply ozone at the time of the need, and its equipment. Moreover, it is going to offer the ozone storage condition which can reduce the operation cost of equipment, and its equipment with a specific combination with an ozone generator.

[Translation done.]

CLAIMS

[Claim(s)]

[Claim 1] An ozone generator is worked and ozone is generated. A high silica PENTA sill zeolite, Said ozone content gas is supplied to the ozone storage tank filled up with one sort or two sorts or more of ozone adsorbents chosen from the group of dealuminization faujasite and meso porous silicate. - Adsorb and store ozone at the adsorption temperature of the range of 100 degrees C - 0 degree C, and cool said ozone content gas beforehand using the oxygen concentration gas of the low temperature which flows out of said ozone storage tank. On the other hand, the storage condition of the ozone characterized by suspending the aforementioned ozone generator at the time of use of ozone, and collecting ozone from said ozone storage tank by heating desorption, heating purge desorption, reduced pressure desorption, reduced pressure purge desorption, or heating under reduced pressure purge desorption.

[Claim 2] The storage condition of the ozone according to claim 1 characterized by carrying out heating desorption and collecting ozone by setting up said adsorption temperature in -60 degrees C - -30 degrees C, and setting up said desorption temperature in 0-30 degrees C.

[Claim 3] The storage condition of the ozone according to claim 2 characterized by heating the purge gas suitable for the purpose of using ozone in said desorption process, carrying out heating purge desorption of a sink and the ozone for said purge gas to the gas stream and hard flow of said adsorption process, and collecting ozone.

[Claim 4] The storage condition of the ozone according to claim 1 characterized by collecting ozone by reduced pressure desorption by setting said adsorptive pressure force as the range of 1-5atm, and setting said desorption pressure as the range of 0.04-0.3atm.

[Claim 5] The storage condition of the ozone according to claim 4 characterized by collecting ozone for the purge gas suitable for the purpose of using ozone by the sink and reduced pressure purge desorption to the gas stream and hard flow of said adsorption process in said desorption process.

[Claim 6] The storage condition of the ozone according to claim 5 characterized by heating and carrying out heating under reduced pressure purge desorption of said purge gas, and collecting ozone.

[Claim 7] The storage condition of ozone given in any 1 term of claims 1-6 characterized by introducing into the hydrogen pole room of said water electrolysis ozone generator said oxygen concentration gas which flows out of said ozone storage tank, using a water electrolysis ozone generator as said ozone generator, and reducing the power consumption of said water electrolysis ozone generator according to an oxygen depolarization operation.

[Claim 8] The storage condition of ozone given in any 1 term of claims 1-6 characterized by returning said oxygen concentration gas which flows out of said ozone storage tank to the oxygen raw material side of said silent discharge ozone generator, using a silent discharge ozone generator as said ozone generator.

[Claim 9] In the ozone storage equipment which has an ozone generator and the condensator attachment heat insulation machine which held the ozone adsorption tub A water electrolysis ozone generator is used as an ozone generator. To said adsorption tub A high silica PENTA sill zeolite, It is filled up with one sort or two sorts or more of ozone adsorbents chosen from the group of dealuminization faujasite and meso porous silicate. Said ozone adsorption tub is connected with said ozone generator with a conduit. the object for ozone content gas supply -- Said adsorption tub and said heat exchanger are connected with a conduit. this -- the object for oxygen concentration gas circulation which prepares a heat exchanger, a condensator, a compressor, and a selector valve in a conduit, and flows out of said adsorption tub -- Connect a conduit to the hydrogen pole room of said water electrolysis ozone generator, supply said oxygen concentration gas to a hydrogen pole room, and oxygen depolarization is urged. furthermore, said object for oxygen concentration gas circulation -- A conduit is connected. said object for oxygen concentration gas circulation -- the edge of said adsorption tub which connected the conduit -- the object for purge gas supply -- A conduit is connected. this -- a conduit -- a heater and a selector valve -- attaching -- said object for ozone content gas supply -- the edge of said adsorption tub which connected the conduit -- the object for ozone recovery -- this, when preparing a selector valve in a conduit and carrying out adsorption storage of the ozone at said ozone adsorption tub said ozone generator and said object for ozone content gas supply -- the condensator of a conduit, and said compressor -- and when controlling a selector valve to work the condensator of said heat insulation machine and to supply ozone content gas to an ozone adsorption tub and carrying out desorption recovery of the ozone from said ozone adsorption tub said ozone generator and said object for ozone content gas supply -- the condensator of a conduit, and said compressor -- and the condensator of said heat insulation machine -- stopping -- said ozone adsorption tub -- said object for purge gas supply -- a conduit and said object for ozone recovery -- the storage equipment of the ozone characterized by forming the controller which controls a selector valve to connect a conduit and to collect ozone.

[Claim 10] In the ozone storage equipment which has an ozone generator and the condensator attachment heat insulation machine which held the ozone adsorption tub A silent discharge ozone generator is used as an ozone generator. To said adsorption tub A high silica PENTA sill zeolite, It is filled up with one sort or two sorts or more of ozone adsorbents chosen from the group of dealuminization faujasite and meso porous silicate. Said ozone adsorption tub is connected with said ozone generator with a conduit. the object for ozone content gas supply -- Said adsorption tub and said heat exchanger are connected with a conduit. this -- the object for oxygen concentration gas circulation which prepares a heat exchanger, a condensator, a compressor, and a selector valve in a conduit, and flows out of said adsorption tub -- A conduit is connected to the oxygen material gas supply side of said silent discharge ozone generator. furthermore, said object for oxygen concentration gas circulation -- A conduit is connected. said object for oxygen concentration gas circulation -- the edge of said adsorption tub which connected the conduit -- the object for purge gas supply -- A conduit is connected. this -- a conduit -- a heater and a selector valve -- attaching -- said object for ozone content gas supply -- the edge of said adsorption tub which connected the conduit -- the object for ozone recovery -- this, when preparing a selector valve in a conduit and carrying out adsorption storage of the ozone at said ozone adsorption tub said ozone generator and said object for ozone content gas supply -- the condensator of a conduit, and said compressor -- and when working the condensator of said heat insulation machine, and controlling a selector valve to supply ozone content gas to an ozone adsorption tub and carrying out desorption recovery of the ozone from said ozone adsorption tub said ozone generator and said object for ozone content gas supply -- the condensator of a conduit, and said compressor -- and the condensator of said heat insulation machine -- stopping -- said ozone adsorption tub -- said object for purge gas supply -- a conduit and said object for ozone recovery -- the storage equipment of the ozone characterized by forming the controller which controls a selector valve to connect a conduit and to collect ozone.

[Claim 11] Storage equipment of the ozone according to claim 9 or 10 characterized by having worked said heater, having heated the adsorbent and making heating desorption possible when attaching a heater to the heat insulation machine which held said ozone adsorption tub and carrying out desorption of the ozone from said ozone adsorption tub.

[Claim 12] said object for ozone recovery -- the storage equipment of the ozone according to claim 9 or 10 characterized by attaching a reduced pressure type ozone recovery means to a conduit.

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[Translation done.]

Client : 333685 - CRAFTMASTER MANUFACTURING, INC.
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**Request Notes**

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